Filtration and Crystallization

Is to separate a mixture or purify a substance

Filtration technique

- The filtration technique is ideal for separating mixtures that contain both an insoluble solid and a liquid.
  - e.g. to separate a mixture of sand and water.

1. Filtration is performed by pouring a mixture over a porous piece of filter paper placed in a funnel.
2. The filtration technique separates solid and liquid substances based on the size of their particles
3. The liquid that passes through the filter paper is called the *filtrate*
4. the solid that remains in the filter paper is called the *residue*.

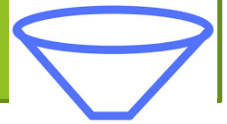
Two filtration methods

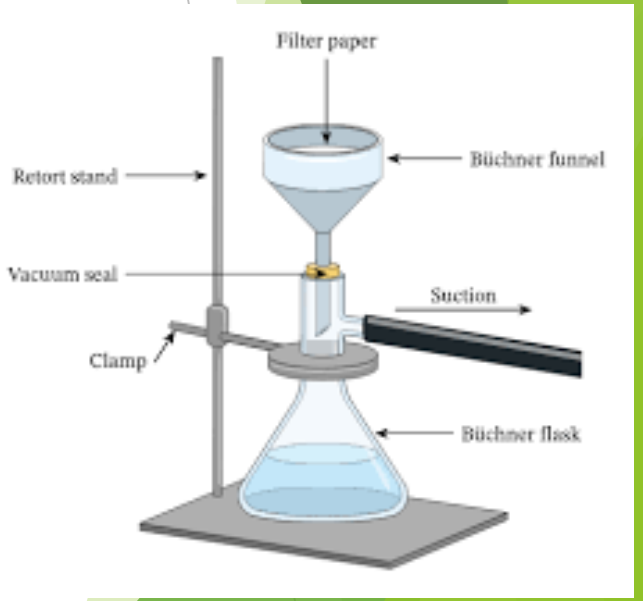
1. Gravity filtration:- a method that tends to be used when there is a large amount of mixture to separate.

- tends to be used when we want to collect the filtrate and
- when the mixture needs to be filtered while it is hot.



use a stemless funnel if we are filtering a hot mixture because crystals can form in the stem and this can prevent filtration processes





Gravity Filtration

- The mixture should be swirled so that the solid particulates are dispersed throughout the liquid. This will allow the solid to be poured more easily and it will help prevent solid particulates from being stuck at the bottom of the glassware.

- pour slowly to avoid splashing and/or overflowing the filter paper.
- It is important that the mixture is poured into the center of fluted pieces of filter paper.

- The mixture should not be poured in between the folded edges and the funnel.

- The solid residue will remain on the filter paper and the filtrate will pass right through.

How To: Performing Gravity Filtration

1. Position a funnel above an Erlenmeyer flask.
2. Fold a piece of filter paper and place it in the funnel.
3. Swirl the flask containing the mixture to be filtered.
4. Slowly pour the mixture into the folded filter paper.
5. Allow the filtrate to drain and repeat until the entire mixture has been separated.

2-vacuum filtration

- A method used when we want to collect all of the solid and when there is a relatively small amount of mixture to separate.
- Büchner funnels are used to perform the vacuum filtration technique.
- A Büchner funnel serves the same purpose as a stem funnel. The main differences are that a Büchner funnel tends to be made of ceramic instead of glass and it also has a flat plate with many holes on the inside.



1. A circular piece of filter paper should be placed on the flat plate to cover up all the holes.
2. The filter paper should have the same diameter as the Büchner funnel.
3. The filter paper should be flat and it should not be bunched up at any point across the funnel surface.
4. We can ensure that the filter paper lies completely flat over the holes by wetting the paper with a little solvent.
5. We will also need a Büchner flask, sometimes called a side-arm flask.

1. Heavy-walled tubing can be attached to the arm of the flask.
2. The other end of the tubing is attached to a vacuum line or aspirator.
3. The Büchner funnel should be attached to the Büchner flask using a rubber stopper, ring, or vacuum seal.
4. With the vacuum on, we can pour our swirled mixture over the filter paper.
5. The suction will pull the liquid into the Büchner flask, leaving the solid material on the filter paper.

- This method is much faster than the gravity filtration technique for separating mixtures because it relies on very strong suction forces instead of weaker gravity forces.

- ensure that the apparatus is secure by clamping the neck of the Büchner flask.

- We also need to take care not to overflow the Büchner flask. If the liquid in the Büchner flask reaches the arm, the liquid will be pulled into the vacuum line.

How To: Performing Vacuum Filtration

1. Place a vacuum seal and Büchner funnel into a Büchner flask.
2. Place a piece of filter paper the same diameter as the funnel into the Büchner funnel.
3. Attach the arm of the Büchner flask to a vacuum line or aspirator with heavy-walled tubing.
4. Turn on the vacuum.
5. Wet the filter paper with a little solvent, ideally the same liquid as is in the mixture.
6. Verify that the vacuum seal is good by listening for a sucking noise as the solvent is pulled into the flask.
7. Swirl the flask containing the mixture to be filtered.
8. Slowly pour the mixture over the filter paper until the entire mixture has been separated.

Crystallization and evaporation

- When a mixture contains a soluble solid and a liquid, for example, salt water, we can separate the two components by allowing the soluble solid to crystallize.
- the liquid, also called the solvent, will be driven off by applying heat to the mixture.
- This means that only the soluble solid can be collected.
- This soluble solid can also be called the solute.

Two methods for producing crystals.

1-the crystallization technique

2-the crystallization technique

1-the evaporation technique:

1. is used if the solution is known to only contain one solute.
2. be used if the solution does not contain any impurities and
3. do not need to grow large regular crystals.

procedure

1. Evaporation is performed by first putting the test solution in an evaporating dish or evaporating basin.
2. The solution can then be placed out in the open to allow the solvent to evaporate naturally.
3. The solution can also be placed over a heat source to speed up the evaporation process.
4. The solution should never be heated too rapidly. Gentle heating helps to prevent the rapid boiling and bumping that cause some of the solution to be expelled from the dish.
5. The solvent will begin to evaporate as the heat is applied and the solution will become more and more concentrated.

- the solution becomes supersaturated and it can no longer hold all of the solute.
- small crystals will begin to form on the surface of the liquid or on the edges of the evaporating dish.
- We should continue to heat the solution until the majority of the solvent has evaporated.
- The crystals should not be heated until they are completely dry as some crystals readily decompose upon further heating.
- Small crystals will line the dish, and they can be separated from the remaining solution using the filtration technique.
- As these crystals are formed rapidly, they will be small. In addition, if there were any impurities in the solution, they will also crystallize or become trapped within the solute's crystal structure.

How To: Performing Evaporation

1. Place the solution to be separated in an evaporating dish.
2. Set the evaporating dish over a heat source.
3. Slowly heat the evaporating dish until the majority of the solvent has evaporated.
4. Use a filtration technique to filter the resulting crystals from any remaining solution.

2-The second method

The crystallization technique

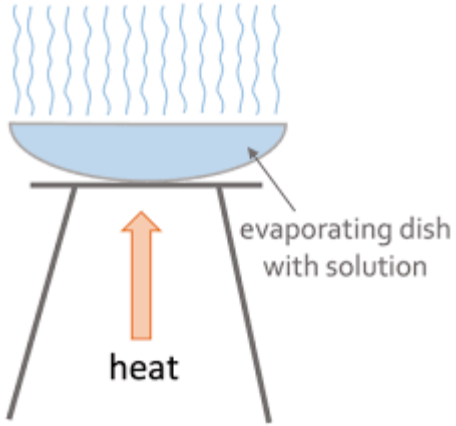
1. The crystallization technique, is used if the solution is known to contain two or more solutes that have different solubilities.
2. The crystallization technique should also be used if the solution contains impurities or if we want to grow large regular crystals.
3. The process of crystallization begins the same as evaporation.
4. However, the evaporating dish is removed from the heat source once small crystals begin to form on the surface of the liquid or on the edges of the evaporating dish.
5. We should then set the evaporating dish aside and allow it to continue to cool.
6. Less and less solute will be able to remain in solution as it cools down.
7. The excess solute will precipitate out as large regular crystals.
8. We can cause even more crystals to form by placing the evaporating dish in an ice bath.

How To: Performing Crystallization

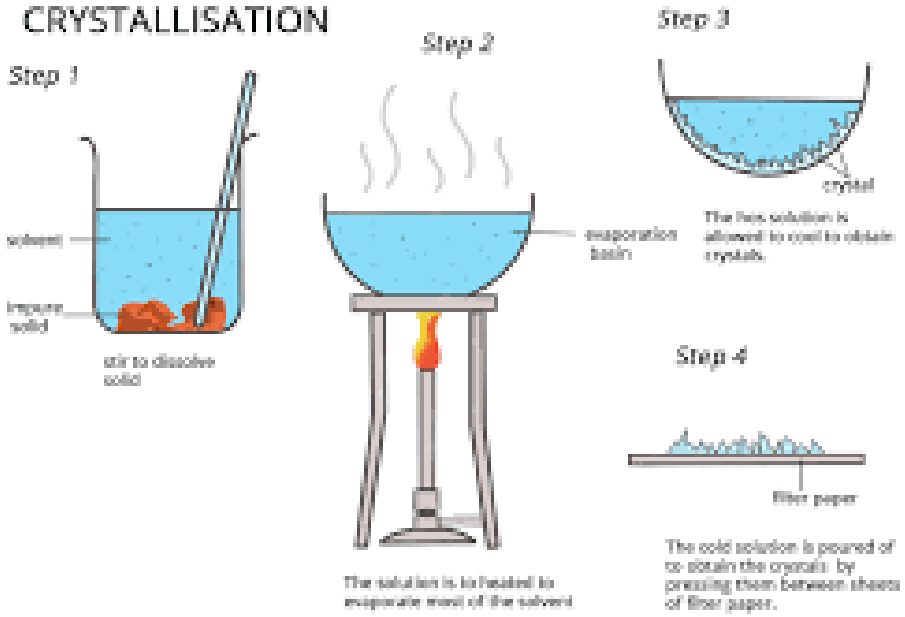
1. Place the solution to be separated in an evaporating dish.
2. Set the evaporating dish over a heat source.
3. Slowly heat the evaporating dish until crystals just begin to form.
4. Remove the evaporating dish from the heat and allow to cool.
5. Use a filtration technique to filter the resulting crystals from the remaining solution.

Crystallization diagram

- Evaporation



Crystallization



Key Points

1. Insoluble solids can be separated from a liquid using filtration.
2. Gravity filtration is preferred when the filtrate is desired after separation, there is a lot of mixture to separate, or the mixture needs to be filtered while hot.
3. Vacuum filtration is preferred when the solid is desired after separation or when there is a small amount of mixture to separate.
4. Soluble solids can be separated from a liquid by crystallizing the solid.
5. Evaporation is preferred when the solution is known to contain only one solute, the solution does not contain any impurities, and we do not need to grow large regular crystals.
6. Crystallization is preferred when the solution is known to contain two or more solutes that have different solubilities, when the solution contains impurities, or if we want to grow large regular crystals.

End